ADAPTING A SYSTEM BANDWIDTH TO BE USED BY A USER EQUIPMENT FOR AN UPLINK COMMUNICATION CHANNEL

FIELD OF THE INVENTION

[0001] The present invention relates to the field of cellular communication networks and in particular to link adaptation in the uplink direction.

BACKGROUND OF THE INVENTION

[0002] In cellular network systems, the conditions of communication links or channels between different network elements, for example user equipments (UEs) and base stations, may change from time to time. Thus, link adaptation is used for adapting the communication between user equipments and base stations considering the change conditions. This may be done inter alia by changing the modulation and/or coding scheme (MCS), for instance by increasing or lowering the MCS level.

[0003] Current link adaptation methods target at lowering of the used bandwidth per UE and increasing of the MCS level when the UE is in a bad radio frequency condition resulting from power limitations. This may lead, especially in low load scenarios, to a power inefficient transmission which indeed contradicts the Shannon theorem which says that for a given data rate it is more power efficient to use low MCS levels and to increase the transmission bandwidth instead of the contrary.

[0004] In view of the above-described situation, there exists a need for an improved technique that provides a cellular communication system being able to provide efficient and improved link adaptation.

SUMMARY OF THE INVENTION

[0005] This need may be met by the subject matter according to the independent claims. Advantageous embodiments of the herein disclosed subject matter are described by the dependent claims.

[0006] According to a first aspect of the invention, there is provided a method for adapting a system bandwidth to be used by a user equipment for an uplink communication channel for an uplink communication between the user equipment and a base station within a cell of a cellular network, wherein the cell is served by the base station, wherein the user equipment is adapted to use a predefined system bandwidth for the uplink communication. The method comprises determining an actual block error rate of the uplink communication channel, comparing the actual block error rate with a predefined threshold, and adapting the predefined system bandwidth based on the result of the comparison.

[0007] This aspect may be based on the idea to use the block error rate as a robust and accurate measurement and basis for decision of appropriate bandwidths.

[0008] In current system concepts, power headroom report (PHR) has been used for adaptation methods to determine the to-be-used modulation and coding scheme (MCS) and bandwidth. Such methods may reduce the bandwidth or numbers of allocated physical resource blocks (PRBs) per user equipment (UE) proportional to a missing transmit power at a UE, even in a low loaded system. PHR corresponds to a rough path-loss estimation. As such methods target at lowering the used bandwidth per UE and increasing the MCS level when the UE is in a bad RF condition, this may lead, especially in low load scenarios, to a power inefficient transmission which indeed contradicts the Shannon theorem according to which, for a given data rate, it is more power efficient to use low MCS levels and to increase the transmission bandwidth instead of the contrary.

[0009] The herein described method does not base the decision about the bandwidth only to PHR as feedback for the decision process, but introduce the utilization of the block error rate (BLER) measurements as main criterion for determination of the to be used bandwidth for each UE.

[0010] BLER estimation is a very robust and accurate measurement in contrast to the rough PHR measurement which is based on a rough path-loss estimation only. BLER is defined as the ratio of the number of erroneous blocks received to the total number of blocks sent. An erroneous block is defined as a Transport Block, the cyclic redundancy check (CRC) of which is wrong.

[0011] The base station may be any kind of base station or eNodeB (eNB) being able to provide the above mentioned functionalities. The user equipment may be a regular LTE device being able to communicate with the base station.

[0012] The total bandwidth available for transmission between UEs and the base station may be shared for uplink user specific data transmission and common signaling transmission. Furthermore the total bandwidth available for uplink data transmission in a cell may be used simultaneously for uplink transmission of the data of multiple UEs allocated in the cell ((“UL shared communication channel”). The split of the shared bandwidth resource is defined via signaling. “Uplink shared communication channel” in this context may refer to a physical uplink shared channel (PUSCH). The allocation of the bandwidth may be controlled and signaled to the UE via physical downlink control channel (PDCCH).

[0013] According to a further embodiment of the invention, the method further comprises determining an actual modulation and coding scheme level used for the uplink communication, comparing the actual modulation and coding scheme level with a predefined minimum threshold for the modulation and coding scheme level, and adapting the predefined system bandwidth based on the result of the comparison of the actual block error rate with a predefined threshold and based on the result of the comparison of the actual modulation and coding scheme level with a predefined minimum threshold for the modulation and coding scheme level.

[0014] According to the herein described method, the MCS level may be considered when deciding about the adaptation of the bandwidth. In particular, a minimum MCS level may be defined as a decision criterion.

[0015] “MCS level” in this context may refer to a modulation and coding scheme of a specific order. A high MCS level corresponds to a high order modulation and high code rate, a low MCS level corresponds to a low order modulation and low code rate. The predefined minimum MCS level may correspond to the lowest order modulation and lowest code rate which can be used or which is appropriate for the used system.

[0016] According to a further embodiment of the invention, if the actual block error rate is below the predefined threshold, adapting the predefined system bandwidth corresponds to increasing the predefined system bandwidth.

[0017] A low BLER (i.e., the quality of the link is good as there are only few erroneous transmitted blocks) shows that power is available, and thus, the bandwidth may be increased.